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STANDARD OPERATING PROCEDURE

Instructions for Calibration and Use of a High-Volume (Hi-Vol) Air Sampler

KEY WORDS

air sampling, XAD resin

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1.0 INTRODUCTION

Expected air concentrations will determine which type of air sampler (high volume or low volume) will be used for a particular study. The Hi-Vol air sampler described in this SOP was designed specifically for the Environmental Monitoring Branch with components from Kurz Instruments (flow controller), General Metal Works (sampling unit), and Sierra Instruments (mounting and calibration plates).

1.1 Purpose

This Standard Operating Procedure (SOP) discusses the set up, calibration and use of high volume (Hi-Vol) air sample pumps for the collection and estimation of pesticides residues in air. Hi-Vol air samplers have a high ratio of airflow to trapping medium and are used to measure low concentrations of pesticides in the part per billion (ppb) range or less over long periods of time (up to 24 hours or more).

2.0 MATERIALS

2.1 High volume air sampling unit
2.2 Metal legs (3)
2.3 Hi-Vol sampling jar, see SOP FSAI001.01
2.4 Pint mason jar filled with pre-measured XAD resin
2.5 Extension cord
2.6 Circular closed-cell rubber gaskets (2)
2.7 Circular metal ring (1)
2.8 Threaded metal rods (3)
2.9 Wing nuts (3)
2.10 Metal mounting plate
2.11 Glass fiber filter paper (8”X10”) (Gelman Sciences Type A/E product 61638)
2.12 Top-hat calibration plate, tubing attached
2.13 Tygon® tubing
2.14 Dwyer manometer
2.15 Fluorescein green dyed fluid
2.16 Mounting wood with magnets
2.17 2 millimeter or small jewelers flat head screwdriver
2.18 Portable gas generator
2.19 Gasoline

2.20 Exhaust hose
2.21 Foil
2.22 Rubber bands
2.23 Ziploc bags (gallon size)
2.24 Styrofoam six pack or archive box with dividers
2.25 Freez-safe® or ice chest
2.26 Dry Ice
2.27 Latex gloves
2.28 Watch or other timer
2.29 Chain of Custody (COC) forms
2.30 Hi-Vol hood

3.0 PROCEDURES

3.1 General

The study objectives should be clearly stated in the protocol so that study methods and sampling procedures may be designed accordingly. Sampling site selection should be tailored to the identified goals of the study. The sites should ensure the integrity of the sample and keep equipment safe from vandalism or theft.

3.2 Hi-Vol setup

3.2.1 Hi-Vol samplers are stored in cardboard boxes which contain the sampling unit (vacuum motor, flow control box and sample mounting unit), three metal legs, extension cord, metal mounting plate with circular cutout and closed–cell rubber gasket on bottom, three threaded metal rods, three wing nuts and a circular metal ring (see Figure 1). Storage boxes should be checked to ensure that all components are there and in working condition prior to taking out in the field.

3.2.2 Remove the sampling unit and the three metal legs from the box. Place sampling unit upside down on top of storage box and insert one leg into each of the three holes in support collar/leg bracket. Securely tighten thumbscrews so that the screws tighten into the groove on the leg. Turn the sampling unit right side up on its legs making sure the unit is on stable, level ground. The plug from the Hi-Vol motor should already be connected to the plug from the Kurz flow meter; if not, they may be connected at this time. Note: never

disconnect the Hi-Vol motor from the flow controller while the power is on, the flow meter will be damaged.

3.2.3 Set up sampler at the desired location and use an extension cord to power the sampling unit. There is no on/off switch on these units; therefore the unit's motor will automatically start up once it is plugged in to an electrical source. If electrical power is not available, a gas generator may be used. Have enough gasoline available to run generator for the sampling period. Place the generator an appropriate distance from the sampling unit so that generator exhaust does not interfere with sample collection.

3.2.4 If sampler unit is being used in an enclosed structure or in an area without generous airflow, an exhaust hose may be attached to the bottom of the motor to exhaust sampled air to a different location. This will ensure that the air is not being resampled through the sample resin.

3.3 Calibration

3.3.1 Set up Hi-Vol as previously described in Section 3.2 but do not start unit.

3.3.2 Obtain one piece of the glass fiber filter paper. The paper has two sides: one side looks like an imprint of mesh screening and the other side looks like natural fiber paper.

3.3.2.1 Carefully place the glass fiber filter paper mesh pattern down onto the screen and center. The paper is delicate and should not be folded.

3.3.2.2 The paper provides some resistance keeping the machine vacuum at an even and consistent flow.

3.3.3 Place the top-hat calibrator (Sierra Instruments)(Figure 2) over the glass fiber paper and tighten the wing nut screws. It helps if all four wing nuts are tightened at the same time (this will take two people) so that the plate is placing even pressure on the rubber gasket, which will reduce the chance of air leaks, or simultaneously tighten wing nuts on the diagonal.

3.3.4 Retrieve the slack tube manometer and loosen the stopcocks on top one or two turns (they should have been tightened prior to storage) until the valves are opened at least halfway. The manometer should be filled with fluorescein green dyed fluid. If there is no fluid in the manometer, fill with the dyed fluid.

3.3.5 Attach manometer to mounting wood with magnets; mounting wood has hook to attach it to the top lip of the sampling unit to make reading the manometer easier. (Figure 3)

3.3.6 Adjust manometer slide rule so that zero is at the bottom of the fluid meniscus.

3.3.7 Attach one end of the Tygon® tubing to one of the stopcocks and the other end to the top-hat calibrator.

3.3.8 Plug in sampling unit and let run for a minimum of five minutes prior to any calibration. Check for air leaks. The most common areas for leaks are the rubber gasket on the calibration plate and the plastic connector between the motor and throat of the sampling device

3.3.9 In the sampling unit control box there are two flow adjust screws (potentiometers). One has been covered with red paint to keep it from being adjusted, this is factory adjusted so do not attempt to adjust it. The other screw is the one that is adjusted to calibrate the flow (Figure 4).

3.3.9.1 Adjust the flow of the sampler by turning the screw with a 2-millimeter or small jewelers flat head screwdriver; clockwise increases, counterclockwise decreases flow.

3.3.9.2 The flow adjust should be fairly sensitive, if not see Section 4.0.

3.3.10 For most studies, 1 cubic meter air/minute (or 1000 Liters/minute) has been used, although the unit can be adjusted up to 2 cubic meters/ minute.

3.3.10.1 To adjust the flow to 1 m^3/ minute, adjust the flow screw until the fluid level on one side of the manometer reaches 4.3 inches.

3.3.10.2 Let the sampling unit run for another five minutes and check the calibration. If it is holding steady at 4.3 inches then calibration is complete; if the calibration has changed, check for air leaks, recalibrate, and wait another five minutes.

3.3.11 If a flow other than 1 m^3/ minute is desired the chart in Attachment 1 can be used to make the conversion between volume of air and inches of pressure.

3.3.12 After calibration it is important to store the top-hat calibrator in a way that will not crease the closed-cell rubber gasket bottom. Also, the stopcocks on the slack tube manometer should be hand tightened to prevent the fluid from leaking or evaporating causing the dye to form a crust.

3.4 Sampling Methods

3.4.1 Wearing clean, latex gloves set up Hi-Vol according to Section 3.2 but do not start unit. Obtain a piece of the glass fiber filter paper and position according to Section 3.3.2.

3.4.2 Place the mounting plate over the glass fiber filter paper and hand tighten the wing nuts so that the mounting plate is securely in place. It helps if all four wing nuts are tightened at the same time (this will take two people) so that the plate is placing even pressure on the rubber gasket, which will reduce the chance of air leaks, or simultaneously tighten wing nuts on the diagonal.

3.4.3 Screw the three threaded metal rods into the mounting plate (may already be attached to the plate).

3.4.4 Place one of the circular rubber gaskets inside the metal rods (rubber gaskets should be stored and packaged along with the pre-packed Hi-Vol resin jars according to SOP FSAI001.01).

3.4.5 Check the moisture of the XAD resin in the mason jar. The resin has been washed with solvent and dried. The resin should appear moist, but not wet. WARNING: RESIN CONTAINING TOO MUCH SOLVENT MAY CAUSE AN EXPLOSION WHEN THE HI-VOL IS TURNED ON. Empty mason jar filled with clean, pre-measured XAD resin into Hi-Vol sample jar, screened end down, making sure

resin bed is level and covers the entire bottom of the jar. The resin may adhere to the glass mason jar, so tap out as much as possible.

3.4.6 Place the Hi-Vol sample jar on top of the gasket. Center the other gasket on top of the Hi-Vol sample jar and then place the circular metal ring on top of that matching the holes in the ring to line up with the metal rods.

3.4.7 Thread wing nuts onto the metal rods and hand tighten until a good seal is made around the edges of the jar and gaskets. Do not over tighten as this may crack the Hi-Vol sample jar (Figure 5).

3.4.8 When sampling in rainy weather, place a Hi-Vol hood over the sampling unit.

3.4.9 Ensure that the Hi-Vol motor is connected to the Kurz controller before connecting to power (see Section 3.2.2). Turn on Hi-Vol motor by plugging the extension cord either into a wall outlet or generator. Let motor run for 5 minutes checking for suction leaks. After 5 minutes the motor speed should not be fluctuating in sound, if it is refer to Section 4.0. If using a generator, be aware of how long the sampler can run before gas is needed.

3.4.10 Fill out Chain of Custody (COC) according to SOP ADMN006.01. Record start time and any other pertinent information.

3.4.11 At sample collection time, using clean, latex gloves turn off sampler and record the end time on the COC making sure all information has been completely filled out.

3.4.12 Remove Hi-Vol jar from the sampler and cover the top with foil using a rubber band to secure it. Place the jar in a Ziploc bag and place upright into a Styrofoam six-pack container in a Freez-safe® with dry ice.

3.4.13 If calibrating in the field, the calibration may be checked at this time. Record end flow rate on COC and then adjust flow if necessary for the next sampling interval.

4.0 REMEDIAL ACTION IN CASE OF MALFUNCTION

If motor speed is fluctuating (revving high and low), check for suction leaks. The most common areas for air leaks are around the rubber gaskets on the calibration and mounting plates and the plastic connector between the motor and throat of the sampling device. If the mounting and calibration plates have been improperly stored and there are creases in the closed-cell rubber gaskets, the plates can be left in the sun and the rubber will return to its original shape.

During calibration, the flow adjust screw (potentiometer) should be fairly sensitive when adjusting the flow. If the screw does not change the flow after several turns this is a sign that the flow controller needs to be replaced. Contact manufacturer.

If the dye in the slack tube manometer has evaporated and left a residue, a solution of hot water and soap may be squirted into the tubing to dissolve the dye. Drain out the dissolved dye and soap mixture and refill with fluid as described in section 3.3.4.

Check glass fiber filter paper in between sampling periods to ensure that it does not get clogged, this is especially important in dusty areas. If clogged, replace the paper.

5.0 SAFETY

Safety equipment should be available to personnel at all times in the field. It is the responsibility of the study coordinator to determine the appropriate safety equipment necessary for the specific chemical being monitored. The Field Health and Safety Program Guide should be consulted to ensure that all appropriate precautions are followed, especially sections 3.2 Travel Safety, 3.3 Site Safety, 5.9 Air Sampling, 6.3 Night Safety, and 6.9 Private Facilities.

Entering treated areas prior to the expiration of the restricted entry interval (REI) requires personal protective equipment described on the pesticide label or in regulation. Consult with the field safety officer prior to the study if samplers are to be placed inside a treatment area and the area must be entered prior to the expiration of the REI.

The resin has been washed with solvent and dried. The resin should appear moist, but not wet. RESIN CONTAINING TOO MUCH SOLVENT MAY CAUSE AN EXPLOSION WHEN THE HI-VOL IS TURNED ON.

6.0 STUDY-SPECIFIC DECISIONS

6.1 Sample location

6.2 Sample interval duration

6.3 Hi-Vol flow rate

6.4 The amount of XAD resin in the mason jar is usually 125 mL, but other amounts may be used.

6.5 Prior to sampling a new chemical, it may be necessary to conduct a trapping efficiency study (T.E.S.) (SOP FSAI003.00) to ensure that breakthrough does not occur.

6.6 If there are significant changes in methodology such as interval duration, flow rate, amount of resin, or type of resin container since the initial T.E.S. for a particular chemical/air sampling method was done, then a new T.E.S. must be conducted according to FSAI003.00.

7.0 REFERENCES

California Department of Pesticide Regulation. 1998. Injury and Ilness Prevention Program. Field Health and Safety Program Guide.
http://empm/em/web/docs/policy/fsafety.pdf

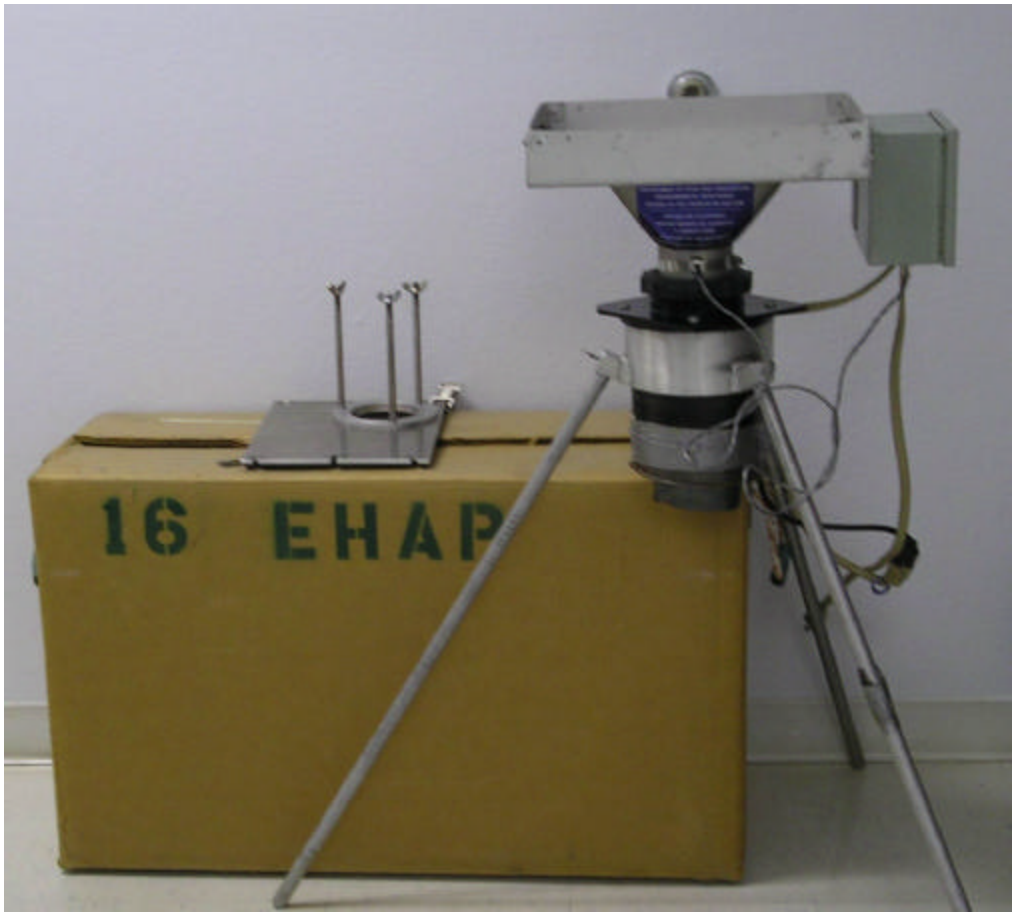


Figure 1. Contents of Hi-Vol storage box. Includes sampling unit (vacuum motor, flow control box and sample mounting unit), three metal legs, extension cord, metal mounting plate with circular hole and closed–cell rubber gasket on bottom, three threaded rods, three wing nuts and a circular metal ring.

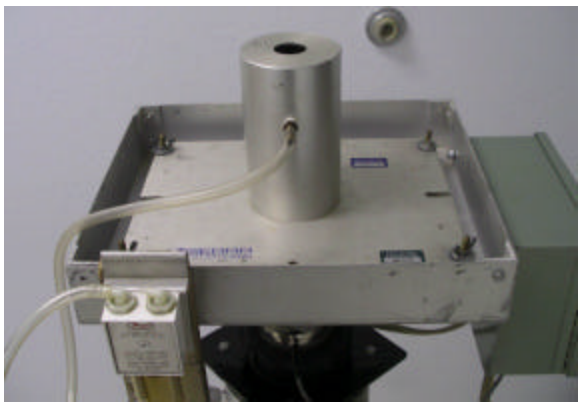


Figure 2. Top-hat calibrator.

Figure 3. Hi-Vol calibration showing placement of manometer

Figure 4. Hi-Vol control box

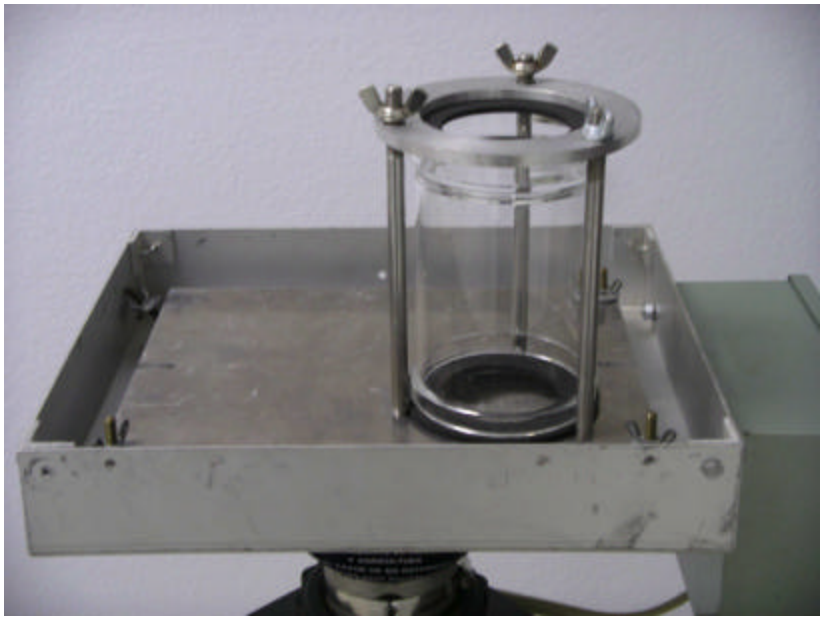
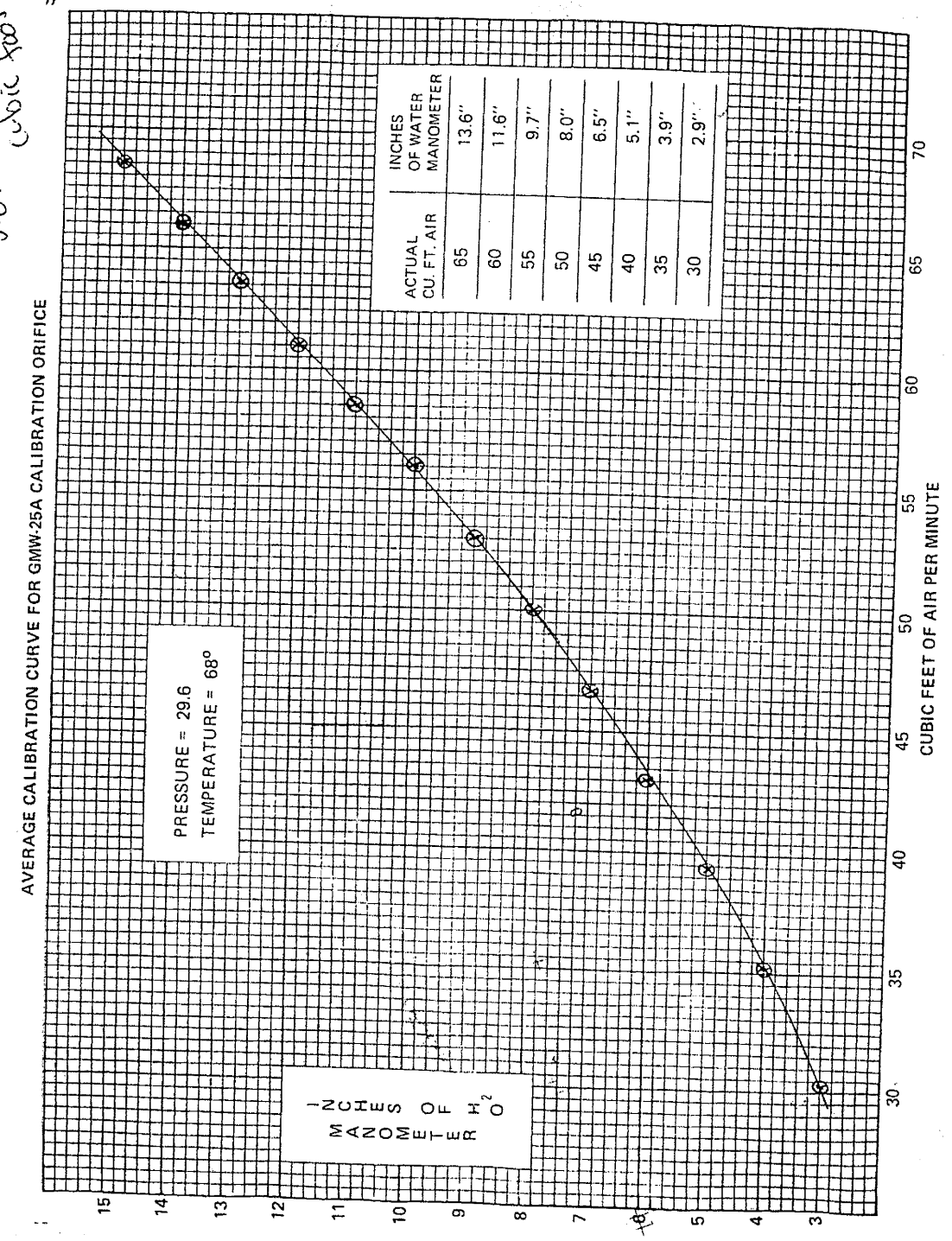


Figure 5. Hi-Vol mounting plate with sample jar
(note: jar has not been prepared with XAD resin)



4.3 = 1,000 L/min = 1 m³/min

28.32 liters per cubic foot